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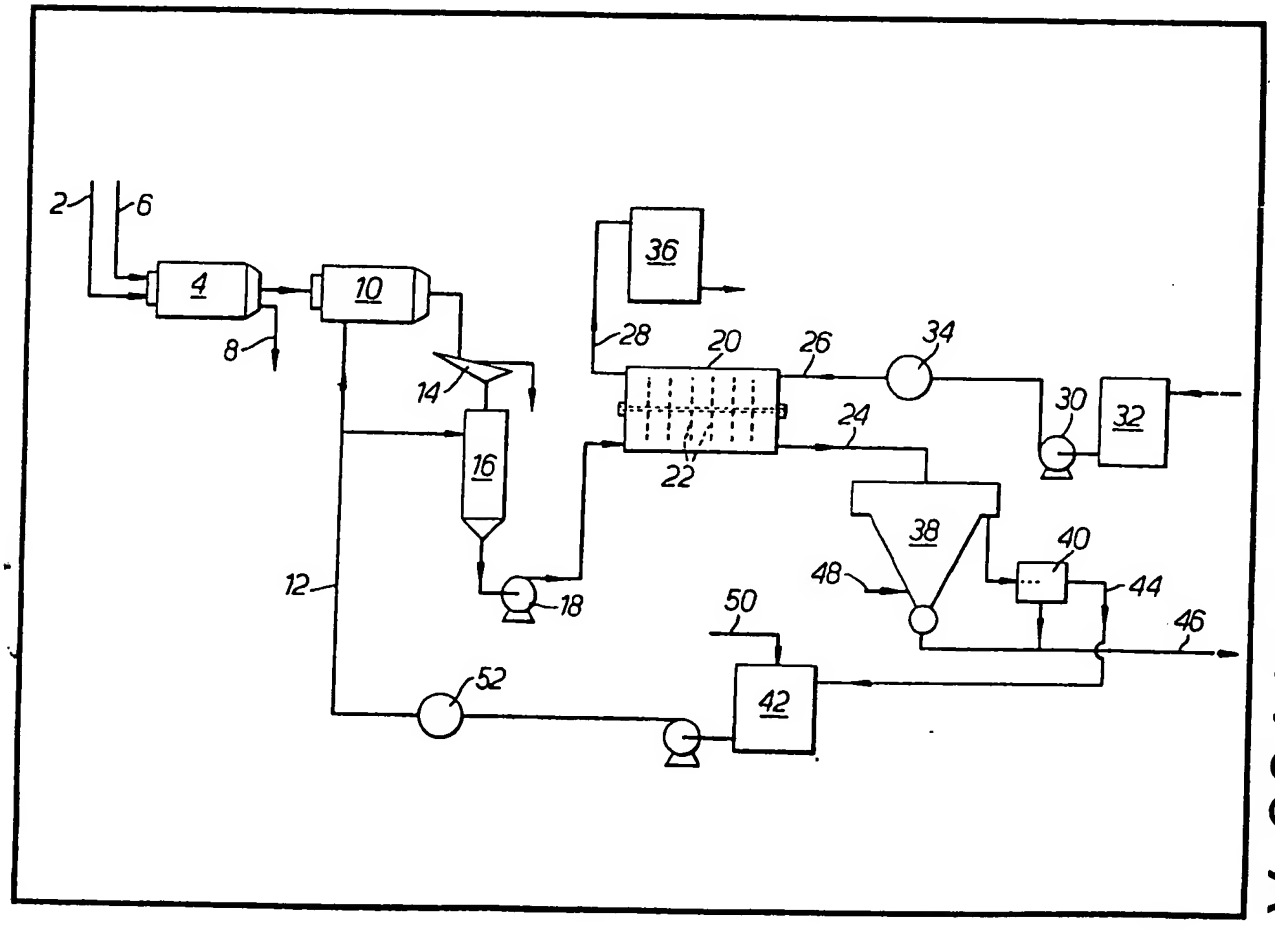
(54) Extraction of bitumen from oil sands

(57) Prior to the extraction of bitumen oils from oil-sands 2, the oil-sands are treated at 4 with cold water 6 at a temperature of less than 30°C to separate clay fines as a dispersion 8 of clay in water, the remaining oil-sands are thereafter treated at 10 with water 12 at a temperature exceeding 60°C. to free the bitumen from the sand. The released bitumen can be extracted from the hot aqueous slurry with kerosene 26. The cold water 2 can contain a deflocculant, such as sodium silicate, tetrasodium pyrophosphate and sodium polyacrylate.



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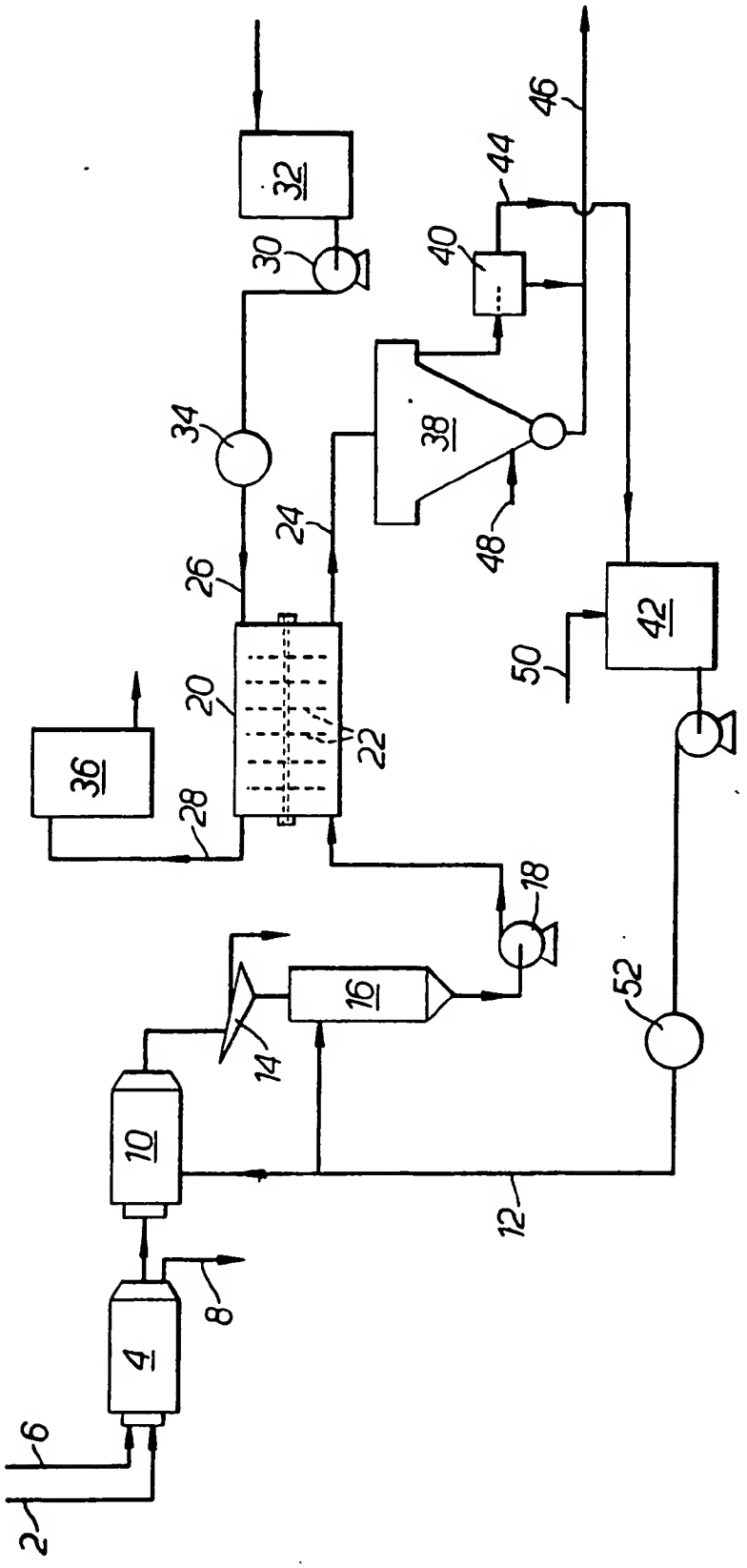

SPECIFICATION

Extraction process

This invention relates to the extraction of bitumen oils from oil-sands. While the invention is applicable to the well known hot-water process for oil-sands, it is primarily intended for use with the solvent extraction of oil-sands, as exemplified by U.K. Patent specification No. 1527269.

Oil-sands as mined contain, as well as sand, water and a mixture of oils referred to as "bitumen oils", a minor proportion of clay fines, the quantity of which varies from deposit to deposit. The presence of clay fines causes problems in the bitumen oils extraction process. Thus, in the hot water process, the fines create emulsions and colloidal suspensions, which at the end of the extraction process are discharged to the tailing ponds with accompanying heavy losses of the bitumen oils. Such emulsions and colloidal suspensions are largely avoided in the solvent extraction process of the above mentioned patent specification, but the clay fines cause other problems: they become wetted by the solvent, which is usually kerosene, with a resulting solvent loss. More serious is the migration of some of the bitumen oils in association with the fines from the solvent phase to the aqueous phase. Before the water, in which the fines are carried, is recycled to the feed end of the process, the fines must be largely removed and the presence of hydrocarbons—the solvent and bitumen oils—adversely affects the operation of the clarifying and thickening equipment supplied for that purpose.

An object of the invention is to reduce the proportion of clay fines in oil-sands prior to the treatment of the latter for extraction of the bitumen oils.

In accordance with one aspect of the present invention, a process for the extraction of bitumen oils from oil sands includes the preliminary steps of conditioning the oil-sands with cold water at a temperature of less than 30°C, removing the resulting dispersion of clay in water, and thereafter conditioning the remaining oil-sands with water at a temperature exceeding 60°C.

The invention is based on the discoveries that bitumen oils become free from the other constituents of the oil-sands when treated with water at a temperature above 60°C, e.g. between 60°C and 100°C, and that clay materials in the oil-sands form a slurry with cold water at a temperature below 30°C, e.g. between 5°C and 30°C. The preliminary conditioning step of the invention thus removes from the oil-sands feed substantially all the clay fines, without loss of the bitumen oils, and avoids the difficulties previously caused by the clay fines.

Preferably, each of the conditioning steps takes place in a rotary digester, designed to form a water slurry of the clay constituents and of the remaining oil-sands constituents, respectively.

Advantageously, the cold water employed in the first conditioning step includes a deflocculant which leads to the rapid separation of the clay slurries in that first conditioning step and in the deposit of any remaining clay fines in the second conditioning step. Suitable defloccculants are sodium silicate, tetra sodium pyrophosphate, and sodium polyacrylate.

While the invention is applicable to the hot water process for the extraction of bitumen oils it is illustrated in the accompanying drawing by its use in a solvent extraction process of the kind described in U.K. patent specification No. 1527269.

In the process illustrated in the drawing raw oil-sands as mined are fed on line 2 into a first rotary digester 4 with cold water on line 6 at between 5°C and 30°C and a minor proportion of a deflocculant. In that digester, an aqueous slurry of the clay constituents are formed, but the bitumen oils are not freed and are retained by the sand of the oil-sands. The slurry is discharged to waste on line 8, while the non-slurried constituents are fed to the second digester 10 with hot water at between 60°C and 100°C; that water may be the water recycled on line 12, heated if necessary by injected steam. The resulting slurry containing freed bitumen oils is directed over a screen 14, which removes foreign bodies. The slurry passes through the screen 14 to head tank 16 where more hot water from recycle line 12 is added as necessary to adjust the temperature and maintain the solids in suspension. The hot tar-sand/water slurry is pumped by pump 18 to a solids/liquid contactor 20 where solvent extraction of the bitumen oils takes place, for example using kerosene as solvent.

The contactor 20 consists of a stationary shell in which a rotor is mounted for rotation about its axis. The rotor includes a number of axially-spaced circular discs 22 which separate the interior of the shell into a series of compartments. The edge of each disc 22 is spaced from the wall of the shell, so that adjacent compartments are in communication via annular gaps between the discs and shell. In each compartment, there is a series of spaced buckets or receptacles which are carried between the discs of that compartment. Some or all of the buckets may have their leading edges extended across the gap between the discs 22 and the shell to act as scrapers and to ensure solids at the bottom of the shell are scooped by the buckets. The final compartment, i.e. that at the right hand end of the contactor, is not provided with buckets, to facilitate removal of the stripped sand.

The hot tar-sand/water slurry enters the contactor 20 as a stream at one end of the contactor, passes progressively from compartment to compartment of the contactor via the circumferential gaps and is discharged as a discard stream through a line 24 at the bottom of the other end of the contactor. At the same time solvent for the bitumen oils of the tar-sand is introduced on line 96 into the top of the contactor 20 as a countercurrent solvent stream and discharges through line 28 at the top of the end of the contactor through which the tar-sand slurry enters. The solvent is pumped by pump 30 from a solvent storage tank 32 and may be heated in a steam heater 34, before entering the contactor 20. The solvent stream, being virtually immiscible with water, forms a distinct and separate phase above the feed stream; the operation of the system is so arranged that the interface between the two phases remains approximately static at or adjacent the axis of the contactor. That axis does not depart substantially from the horizontal, but may be inclined downwardly at a small angle less than 8° to the horizontal from the entry end to the discharge end of the tar-sand/water stream, in order to assist the flow of the solids of the tar-sand through the contactor.

As the tar-sand/water stream passes through the contactor 20, it is continuously treated in each compartment by the rotary buckets, solids of the tar-sand being scooped up and raised by the buckets, and discharged progressively from those buckets in the upper half of the shell, so that they are tumbled, or showered, through the solvent stream. Being denser than either the solvent or water, the solids discharged from the buckets rapidly pass through the solvent stream and settle at the bottom of the shell. The rotary buckets also carry down solvent from stream and into the tar-sand/water stream, being discharged as droplets which rapidly return upwardly into the solvent stream.

Thus, during the progress of the tar-sand through the contactor 20, the tar-sand particles are first disintegrated, if they have not been so treated prior to entry, and the solids are repeatedly showered through the solvent of the solvent stream in each successive compartment of the contactor, so that the bitumen oils are progressively dissolved in the solvent stream and the sand and fines of the feed stream are progressively stripped of bitumen oils. Finally the sand and fines, without significant bitumen oils, are discharged with water through the discharge line 24.

The bitumen oils solution from the contactor 20 is directed on line 28 to storage tank 36 from which it is passed to a solvent recovery plant which separates the solvent from the bitumen oils and recycles the solvent back to the solvent tank 32.

The discard stream of sand, fines and water, freed from bitumen oils and solvent, flows on line 24 from contactor 20 to the sand clean-up unit. That unit includes a conical separator 38 from which water and fines overflow to centrifugal separator 40, the water being returned to storage tank 42 via line 44 and the fines being withdrawn via line 46. Steam is supplied to separator 38 on line 48 and sand is withdrawn from the bottom of the separator via line 46. Water from tank 42 with make up water supplied on line 50 is pumped and heated in steam heater 52 for supply to line 12.

CLAIMS

1. A process for the extraction of bitumen oils from oil-sands comprising the preliminary steps of conditioning the oil-sands with cold water at a temperature of less than 30°C, removing the resulting dispersion of clay in water, and thereafter conditioning the remaining oil-sands with water at a temperature exceeding 60°C.

2. A process according to claim 1 wherein each of the conditioning steps takes place in a rotary digester capable of forming respectively a water slurry of the clay constituents and of the remaining oil-sands constituents.

3. A process according to claim 1 or 2, wherein the cold water of the first conditioning step includes a deflocculant.

4. A process according to claim 3, in which the deflocculant is selected from sodium silicate, tetrasodium pyrophosphate and sodium polyacrylate.

5. A process according to any one of claims 1 to 4, in which after the said preliminary steps the bitumen oils are solvent extracted in a contactor through which the aqueous oil-sands and a solvent flow as substantially separate phases, the contactor being formed with rotatable discs dividing the contactor into interconnecting compartments, the discs carrying means to transfer portions of the aqueous oil-sands into the solvent and portions of the solvent into the aqueous oil-sands during passage of the phases through the contactor.

6. A process according to claim 5 in which the phases flow in countercurrent through the contactor.

7. A process according to claim 1 substantially as described herein.

8. A process for the extraction of bitumen oils from oil-sands substantially as described herein with reference to the accompanying drawing.

9. Bitumen oils when extracted by the process of any one of the preceding claims.

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